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(54) Name of the invention: Inorganic Fiber Formed Body and Catalyst Converter

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(54) [Name of the invention]

Inorganic Fiber formed Body and Catalyst Converter

(57) [Abstract]

[Subject]

To suggest an inorganic fiber formed (molded) body that is improved so that at the time when it is used as a monolith support is easily attached onto the casing and also it stably fixes the monolith, and also to suggest a catalyst converter that advantageously uses the above inorganic fiber formed body.

[Solution measures]

The inorganic fiber formed body according to the present invention is formed a a first inorganic fiber mat and a second inorganic fiber mat are laminated as layers. The first inorganic fiber mat has a structure that is formed from a crystalline alumina fiber mat that is compressed in the direction of the thickness and an organic binder material; and the second inorganic fiber mat has a structure that is formed mainly from a mat formed from a ceramic fiber other than the above described, an inorganic expandable material and an organic binder material. Also, in the case of the catalyst converter according to the present invention, the above described inorganic fiber formed body is wrapped around the monolith (1) as a monolith support material (3).

[Range of the claims of the invention]

[Claim 1]

[redacted]

Inorganic fiber formed body characterized by the fact that it is an inorganic fiber formed body that is formed as a first inorganic fiber mat and a second inorganic fiber mat are laminated as layers, where the first inorganic fiber mat has a structure formed from a crystalline alumina fiber mat that is compressed in the direction of the thickness and an organic binder material that is homogeneously impregnated into the above described alumina fiber mat, and also that is eliminated by a thermal decomposition, and where the second inorganic fiber mat has a structure that is mainly formed from another ceramic fiber different than the above described and an organic binder material that is homogeneously impregnated into the above described alumina fiber mat, and also that is eliminated by a thermal decomposition, and where the ratio of the thickness of the first inorganic fiber mat relative to the thickness of the whole body of the inorganic fiber formed body is set to be in the range of 20 ~ 80 %.

[Claim 2]

Inorganic fiber formed body according to the above described Claim 1 of the present invention where the crystalline alumina fiber that forms the structure of the first inorganic fiber mat is a fiber with a mulite composition.

[Claim 3]

Inorganic fiber formed body according to the above described Claim 1 or Claim 2 of the present invention where the average fiber diameter of the crystalline alumina fiber that forms the structure of the first inorganic fiber mat is in the range of 3 ~ 8 microns, and also, the fiber length is in the range of 0.5 ~ 500 mm.

[Claim 4]

Catalyst converter characterized by the fact that it is a catalyst converter that has a structure formed from a monolith that is formed in a cylindrical shape and that supports a catalyst material used for the purification of the exhaust gases, a casing that is manufactured from metal that houses the above described monolith and also that is connected to the exhaust gas pipelines, and a monolith support material that is wrapped around the above described monolith and that is placed in the clearance between the monolith and the above described casing; where the above described monolith support material is the inorganic fiber formed material reported according to any of the above described claims 1 ~ 3 of the invention, and also, where the first inorganic fiber mat is placed at the side of the above described monolith.

[Detailed explanation of the present invention]

[0001]

[Technological sphere pertinent to the present invention]

The present invention is an invention about an inorganic fiber formed body and a catalyst converter. And in more details, the present invention is an invention about an inorganic fiber formed body that is used as a monolith support material for catalyst converters that are mainly used in automobiles, and it is easy to assemble and also a stable fixing of the monolith is obtained; and it is also an invention about the catalyst converter that uses the above described inorganic fiber formed body.

[0002]

[Previous technology]

The catalyst converter, as it is well known, is a device that by the use of precious metal catalyst eliminates carbon monoxide, hydrocarbons, nitrogen oxides etc., toxic components that are contained in the exhaust gases from the internal burning engines.

[0003]

In the report disclosed according to the Japanese Patent Application Laid Open Number Hei-Sei 1-240715, a catalyst converter has been reported that uses a monolith support material formed from inorganic fiber formed material. Regarding the above described inorganic fiber formed material, it is a material that has an expandable mat, that has a structure that is mainly formed from a ceramic fiber mat and an organic binder material that is homogeneously impregnated into the above described ceramic fiber mat, and also that is eliminated by a thermal decomposition, and where relative to that mat, an alumina fiber mat is stitch bonded by an organic thread, and a laminated layer body is formed. And it is a material that is designed so that the high temperature thermal deterioration of the thermally expandable mat is prevented by the alumina fiber mat.

[0004]

[Problems solved by the present invention]

However, in the case of the above described inorganic fiber formed body that is used as a monolith support material, because the alumina mat is bulky at the time of the assembly of the catalyst converter, there is the problem that it is stated that the attachment onto the casing is difficult. Not only that, but also, because of the difficulties in the adhesion of the alumina fiber mat relative to the thermally expandable mat, even if the stitch bonding by an organic thread is advantageously used, it is easy for the fibers to be damaged by the stitch bonding, and as a result from that, there is the problem that it has been stated that the supporting force relative to the monolith is decreased.

[0005]

Regarding the present invention, it is an invention that has taken into consideration the above described practical circumstances, and it is invention whose first goal is to suggest an inorganic fiber formed body that is improved so that at the time when it is used as a monolith support is easily attached onto the casing, and also to suggest a catalyst converter that advantageously uses the above inorganic fiber formed body. Also, the second goal of the present invention is to suggest an improved inorganic fiber formed body such that there is no fiber damage and that at the time when it is used as a monolith support it sufficiently demonstrates supporting force relative to the monolith, and the monolith fixing is stable, and also to suggest a catalyst converter that advantageously uses the above inorganic fiber formed body.

[0006]

[Measures in order to solve the problems]

Namely, regarding the first essential item according to the present invention, it consists of the following: it is an inorganic fiber formed body characterized by the fact that it is an inorganic fiber formed body that is formed as a first inorganic fiber mat and a second inorganic fiber mat are laminated as layers, where the first inorganic fiber mat has a structure formed from a crystalline alumina fiber mat that is compressed in the direction of the thickness and an organic binder material that is homogeneously impregnated into the above described alumina fiber mat, and also that is eliminated by a thermal decomposition, and where the second inorganic fiber mat has a structure that is mainly formed from another ceramic fiber different than the above described and an organic binder material that is homogeneously impregnated into the above described alumina fiber mat, and also that is eliminated by a thermal decomposition, and where the ratio of the thickness of the first inorganic fiber mat relative to the thickness of the whole body of the inorganic fiber formed body is set to be in the range of 20 ~ 80 %.

[0007]

Regarding the second essential element according to the present invention, it is contained in the following: a catalyst converter characterized by the fact that it is a catalyst converter that has a structure formed from a monolith that is formed in a cylindrical shape and that supports a catalyst material used for the purification of the exhaust gases, a casing that is manufactured from metal that houses the above described monolith and also that is connected to the exhaust gas pipelines, and a monolith support material that is wrapped around the above described monolith and that is placed in the clearance between the monolith and the above described casing; where the above described monolith support material is the inorganic fiber formed material reported according to any of the above described claims 1 ~ 3 of the invention, and also, where the first inorganic fiber mat is placed at the side of the above described monolith.

[0008]

[Conditions of the practical implementation of the present invention]

The conditions for the practical implementation of the present invention will be explained based on the figures presented. Figure 1, is a three dimensional view diagram in an assembly state showing the structure of the catalyst converter. Figure 2 is a three dimensional view diagram showing the wrapping outline of the monolith support material relative to the monolith. Figure 3 is a three dimensional view diagram showing part of the monolith support material that has a structure that is obtained from an inorganic fiber formed body.

[0009]

Regarding the inorganic fiber formed body according to the present invention, it has a structure that is formed as the first inorganic fiber mat and the second inorganic fiber mat are laminated as layers. And then, as the first inorganic fiber mat an inorganic fiber mat is used that has a structure that is formed from a crystalline alumina fiber mat that is compressed in the direction of the thickness and an organic binder material that is homogeneously impregnated into the above described alumina fiber mat, and also that is eliminated by a thermal decomposition.

[0010]

By the use of the first inorganic fiber mat with the above described specific structure, in the case of the inorganic fiber formed body according to the present invention, at the time when it is used as a monolith support material, it does not become bulky and it demonstrates a significant effect such that it is stated that the attachment to the casing is easily achieved. And not only that but also, because of the fact that it is a material where on the high temperature side the crystalline alumina fiber made first inorganic fiber mat is placed, by that it is possible to eliminate the high temperature thermal deterioration of the subsequently placed second inorganic fiber mat. Then, regarding a preferred condition according to the present invention, it is the case when as the above described crystalline alumina fiber, a fiber with a mulite composition is used. By such a preferred condition, the inorganic fiber formed body according to the present invention is a material that at the time when it is used as a monolith support material, can even further prevent the high temperature thermal deterioration of the second inorganic fiber mat, and it is said to have demonstrated an effect of leading to an even more stable fixing of the monolith.

[0011]

Regarding the substrate material mat that forms the structure of the first inorganic fiber mat, it is an agglomeration of alumina fibers that have been layer laminated almost homogeneously in the direction of the thickness, and it also includes the so-

called blankets or blocks. As the alumina fibers, usually fibers that have a fiber diameter that is in the range of 1 ~ 50 microns, and a fiber length that is in the range of 0.5 ~ 500 mm, are used, however, from the point of view of the restoring force and the shape sustaining properties, it is especially preferred if the alumina fibers used have a fiber diameter that is in the range of 3 ~ 8 microns and a fiber length that is in the range of 0.5 ~ 300 mm.

[0012]

As the composition of the above described alumina fibers, it is an alumina - silica type crystalline material short fiber, and besides the alumina that has a silica content of no more than 5 weight %, namely, the high alumina material that contains at least 95 weight % or more alumina, there is also the usual material where the alumina is in the range of 70 ~ 95 weight %, and also, where the remaining structure is formed from silica. Especially, in the case of the mullite composition fibers where the alumina content is in the range of 72 ~ 85 weight %, it is a material that has excellent high temperature stability properties and elastic strength properties, and it is the preferred alumina fiber material.

[0013]

Regarding the crystalline alumina fiber, compared to the same alumina-silica type material that is non-crystalline (or amorphous), it has excellent thermal resistance properties, and similarly to the ceramic material fibers, it is a material that has an extremely little thermal deterioration like softening compression etc., and because of that, in the case when it is made into a compressed mat, it has ample elastic properties. Namely, it is stated that the mat has high supporting properties at low bulk density , and also that its thermal deformation is small. Consequently, because of the difference in the thermal expansion between the monolith (1) and the casing (2) that is manufactured from metal, the clearance between the monolith (1) and the casing (2) is changed, and even in the case when its bulk density is increased, there is no abrupt change of the supporting pressure relative to the monolith (1).

[0014]

As long as the organic binder is a material can support the compressed mat thickness under normal temperature conditions, and after it is eliminated by a thermal decomposition a restoration of the thickness of the above described mat is obtained, there are no particular limitations and such material can be used. However, it is necessary to prevent the use of organic binder materials that even at temperatures above the temperature of use are not decomposed, and especially, it is necessary to avoid the materials that by hinder the flexibility properties and the restored surface compression properties of the mat that is obtained by the impregnation of this organic binder, and it is necessary to avoid the use of organic binder materials that have such properties that they facilitate the destruction of the monolith (1). As the organic binder material, it is possible to use different types of rubber materials, water soluble macromolecular compounds, thermoplastic resin materials, thermosetting resin materials, etc.

[0015]

As the above described rubber type materials, there are the synthetic rubber materials: copolymer material obtained from ethyl acrylate and chloroethyl vinyl ether, copolymer material obtained from n-butyl acrylate and acrylonitrile, copolymer material obtained from ethyl acrylate and acrylonitrile, etc., acrylic rubber materials; nitrile rubber obtained from a copolymer material from butadiene and acrylonitrile, etc., butadiene rubber materials, etc.; as the water soluble organic macromolecular compounds, there are the carboxy methyl cellulose, polyvinyl alcohol, etc. As the thermoplastic resin materials, there are the acrylic type resins that are acrylic acid, acrylic acid ester, acrylamide, acrylonitrile, methacrylic acid, methacrylic acid esters, etc., homopolymers and copolymers; acrylonitrile - styrene copolymer materials; acrylonitrile - butadiene - styrene copolymer materials, etc. Also, as the thermosetting resin materials, there are the bis phenol type epoxy resins, the Novolac type epoxy resin etc.

[0016]

The water solution, water type emulsion, latex, organic solvent solution of the effective component of the above described organic binder material (here below called for short "binder solution"), are commercially available, and these binder solutions, in the state as they are or diluted with a solvent,

can be used, and because of that a relatively inexpensive price of their usage is obtained. Moreover, it is possible to use one type of these binders and also depending on the requirements it is possible to use a mixture of two materials.

[0017]
Among the above described organic binder materials, it is a preferred option if at least one type of materials is selected from the group of the acrylic rubber, nitrile rubber, carboxy methyl cellulose, polyvinyl alcohol and acrylic rubbers besides the acrylic resin materials, and especially, among the acrylic rubber materials, the nitrile rubbers, etc., synthetic rubber materials, the rubbers that have flexibility properties are especially effective.

[0018]
There are no specific limitations regarding the content of the organic binder material, and it is determined by the type and the shape of the fiber material that forms the structure of the mat, the absolute thickness of the mat, the thickness and the restoring force as a molded formed material containing the organic binder and prior to the assembly with the casing (2). Regarding the binder content, usually it is a good option if relative to 100 weight parts of the alumina fiber the effective component of the organic binder material is made to be within the range of 3 ~ 30 weight parts. In the case when the content of the organic binder material is made to be less than 3 weight parts, it is a case where it is not possible to support the thickness as a formed material by the mat regeneration, and in the case when the contained amount exceeds 30 weight parts, the cost is increased and beside that the flexibility properties of the molded material are lost. From this point of view, it is preferred that the above described organic binder proportion is in the range of 5 ~ 20 weight parts.

[0019]
The first inorganic fiber mat is manufactured by the technological process of the impregnation of the organic binder material into the mat, the technological process where the mat that has been impregnated by the organic binder solution is compressed in the thickness direction, the technological process where in the compressed state as it is, the solvent component of the organic binder solution is eliminated.

[0020]

Regarding the first inorganic fiber formed mat, it is preferred that it has the following here below characteristics. Namely, in the case when temporarily, the structure of the monolith support material is formed only from the first inorganic fiber mat, it is preferred that it is a material that has a restoring force in the range of 0.1 ~ 8.0 kgf/cm2 in the state when it is compressed to the thickness corresponding to the clearance between the outer peripheral surface of the monolith and the inner surface of the casing. Regarding this restoring force, when the monolith is manufactured from ceramic it is made to be in the range of 0.5 ~ 8.0 kgf/cm2, and in the case when the monolith is made from metal, it is made to be in the range of 0.1 ~ 4.0 kgf/cm2.

[0021]

Regarding the above described restoring force, it is demonstrated after the organic binder material that is homogeneously impregnated in the mat is eliminated by a thermal decomposition. regarding the restoring force of the mat, it corresponds to the force (compression force) that is necessary in order to compress the mat to the thickness that corresponds to the clearance between the outer peripheral surface of the monolith and the inner surface of the casing. Consequently, according to the present invention, the above described restoring force is defined by the compression force at the time of the formation of the mat.

[0022]

Regarding the second inorganic fiber formed mat (thermally expandable mat), it has a structure that is mainly formed from a mat obtained from ceramic fiber other than the above described, an inorganic expandable material that is homogeneously dispersed in the above described ceramic fiber mat and an organic binder material, that is homogeneously impregnated and that is also eliminated by a thermal decomposition. Then, regarding the above described second inorganic fiber mat, it functions as an expandable mat, the same way as the support material used in the catalyst converter that is described according to the Japanese Patent Application laid Open Number Hei-Sei 1-240715, and at the temperature region of relatively low temperatures of 600oC or less, it demonstrates excellent expansion properties.

[0023]

As the above described ceramic fiber, it is possible to use ceramic fibers other than the alumina type and the alumina - silica type, for example, alumino silicic acid salt fiber (materials with commercial names - fiber - flux, Cera fiber and Kao wool, etc.), asbestos fiber, glass fiber etc. And as the above described inorganic expandable material, it is possible to use hollow glass micro spheres, bentonite, expandable vermiculite, phlogopite (bronze mica), pearlite. expandable graphite, expandable

fluorinated mica, etc. And as the organic binder material, it is possible to use the same materials as in the above described.

[0024]

Regarding the used amount ratio of each of the above described components, they are set according to the following here below: ceramic fiber: 10 ~ 50 weight %, inorganic expandable agent: 20 ~ 65 weight %, organic binder material: 3 ~ 20 weight %. Also, regarding the formation of the mat, it is a material that can be obtained by using the well known spreading methods, and depending on the requirements, it is also a good option if the mat is formed by layer lamination of the sheets obtained by the spreading. Moreover, in the expandable mat, depending on the requirements it is also possible that as another inorganic filler agent, for example, sepiolite ore material etc., are also contained.

[0025]

According to the present invention, from the point of view of the effective elimination of the high temperature thermal deterioration of the second inorganic fiber mat (expandable mat), it is important that the thickness ratio of the thickness of the first inorganic fiber mat relative to the thickness of the total body of the inorganic fiber formed material, is set to be in the range of 20 ~ 80 %, and preferably in the range of 40 ~ 80 %. Namely, in the case when the thickness ratio of the first inorganic fiber mat is less than 20 %, it is a material whereby it is not possible to sufficiently eliminate the high temperature thermal deterioration of the second inorganic fiber mat (expandable mat). Also, in the case when the thickness ratio of the first inorganic fiber mat exceeds 80 %, it becomes difficult to conduct heat to the second inorganic fiber mat, and there is the anxiety that the expandable material of the above described second inorganic fiber mat would become insufficiently expanded.

[0026]

The first inorganic fiber mat and the second inorganic fiber mat in the inorganic fiber formed body according to the present invention, are materials that can be laminated as laminated layers for example by the following here below methods. i) the method where the fixed by the binder first and second inorganic fiber mats are glued and adhered by using an adhesive agent, ii) the method where on the top of the second inorganic fiber mat, the substrate mat, that is used as the first inorganic fiber mat, is laminated as a layer and after that, in the above substrate material mat an organic binder solution is impregnated, and then after that, it is compressed in the direction of the thickness, and then in the compressed state as it is the solvent of the organic binder solution is removed.

[0027]

According to the above described methods, by using an adhesive agent containing the above described organic binder, it is possible to form a structure where the two mats are adhered. Namely, according to the above described method, the same way as in the case of the used according to the previous technology stitch bonding, there is no bulkiness (high volume) and also, there is no destruction of the fibers of either mat, and as a result from that at the time when it is used as a monolith support it is possible to increase the installation properties, and also, it is possible to eliminate the decrease of the supporting force relative to the monolith.

[0028]

As it is shown according to Figure 3, in the case when the inorganic fiber formed body according to the present invention is used as a monolith support (3), in order to eliminate the distortion and displacement of the monolith support material (3) at the time of the assembly of the catalyst converter, as it is shown according to the presented in Figure 2, at the time when it is wrapped around the monolith (1), mutually grabbing like teeth bonding parts are provided on both edge parts in the direction of the wrapping. These bonding parts can be easily formed by a cutting off technological process etc. Moreover, in Figure 3, the symbol (30) denotes the first inorganic fiber mat, the symbol (31) represents the second inorganic fiber mat, the symbol (3) represents the monolith support material that uses the inorganic fiber formed body according to the present invention.

[0029]

Regarding the wrapping of the monolith support material (3), that is formed from the inorganic fiber formed body according to the present invention, around the monolith (1), it is done so that the first inorganic fiber mat (30) is positioned on the side of the monolith (1). Namely, by the positioning of the first inorganic fiber mat (30) on the side of the monolith (1), it is possible to eliminate the high temperature thermal deterioration of the second inorganic fiber mat (31).

[0030]

Regarding the catalyst converter according to the present invention, as it is shown according to the presented in Figure 1, in summary, it has a structure that is formed from the monolith (1) that is formed in a cylindrical shape and also that supports a catalyst material that is used for the purification of exhaust gases, the manufactured from metal casing (2), that houses the monolith (1) and also, that is connected to the exhaust gas pipelines, and the above described monolith support material (3), that is wrapped around the monolith (1) and that is placed in the clearance between the above described monolith and the casing (2).

[0031]

As the monolith (1), besides the monoliths that have a structure that is formed from

ceramics that have as their main component codeirrite etc., it is also possible to use monoliths that have a structure that is formed from a metal foil material. Especially, the ferrite type stainless steel foil, that has as its base components Fe, Cr, Al or Si, is a preferred material for the structure of the monolith made from a metal material because it has good compatibility with the coating material and the catalyst at the time when it is supporting the catalyst material, and not only that, but also, because it has a relatively small thermal change after the support of the catalyst material. In the monolith (1), usually, Pt, Ph etc., precious metal layers are supported and by that the function as a catalyst is imparted.

[0032]

Regarding the casing (2), it is provided with 2 part clam shell structure that is combined in one body as the two parts, the casing part (2a), that forms the structure of the upper half of the above described casing and the casing part (2b), that forms the structure of the lower half part, are combined. The casing part (2a) and the casing part (2b) each, have the flange parts (21a) and (21b), and these flange parts (21a) and (21b), function as the bonding surface at the time of the joining of the casing part (2a) and the casing part (2b). Also, on both edge parts of the casing part (2b) that is on one side, the connection openings (4) and (5) are provided that are used for the connection to the exhaust gas transport pipe. In Figure 3, the symbols (22a) and (22b) represent the bolt openings for fixing onto the automobile body etc., of the automobile. Moreover, as the metal manufactured casing, it is also possible to advantageously use the casing that has a stuffing structure where the monolith that has been formed in advance into a cylindrical shape has been inserted.

[0033]

In the case when in the casing (2) the monolith (1) is contained, it is not necessary that the monolith support (3) has the same thickness as the clearance that is formed between the outer peripheral surface of the monolith (1) and the inner surface of the casing (2), and even if it is slightly thicker it can be installed. However, in the case when the thickness is too large or the slipping properties of the casing are poor, one part of the fibers of the monolith support material (3) are protruding from the bonding surface of the flange parts (21a) and (21b), and unfavorable conditions are generated such that the bonding becomes impossible, etc., and because of that its thickness is set to be in the range of 1.0 ~ 2.0 times the above described clearance. Regarding the upper limit of this defined value, preferably, it is made to be 1.7 times, and especially preferably, it is made to be 1.6 times the clearance size.

[0034]

The catalyst converter according to the present invention is mainly used in the exhaust gas pipelines of automobiles. And in the case of the catalyst converter according to the present invention, at the time when the high temperature gases from the internal burning engines pass through, the temperature of the monolith

(1), the casing (2) and the monolith support (3) is increased, and the organic binder material that is impregnated in the first inorganic fiber mat (30) and the second inorganic fiber mat (31) is eliminated by a thermal decomposition, and the restoring force of the first inorganic fiber mat (30) is demonstrated and together with that the second inorganic fiber mat (31) expands its volume because of the expansion of its inorganic expandable material. Namely, the monolith (1) is fixed by the restoring force of the thickness of the first inorganic fiber mat (30) and by the volume expansion of the second inorganic fiber mat (31).

[0035]

Also, according to the present invention, the monolith support material (3) is wrapped so that the first inorganic fiber mat (30), that has excellent thermal resistance properties, is placed on the side of the monolith (1), and because of that, it is possible to effectively eliminate the high temperature thermal deterioration of the second inorganic fiber mat (31) of the monolith supporting material (3), and it is possible to sufficiently maintain the surface pressure relative to the monolith (1) following the change of the clearance between the outer peripheral surface of the monolith (1) and the inner surface of the casing (2), that is obtained based on the temperature changes. Especially, as it has been described here above, because in the case of the monolith supporting material (3), there is no damage to the fibers, there is no decrease of the supporting force relative to the monolith (1), and an even more stable fixing of the monolith (1) is achieved.

[0036]

[Results from the present invention]

As it has been explained here above, in the case of the inorganic fiber formed body according to the present invention, at the time when it is used as a monolith support material, it presents a significant effect in that it is said that the installation to the casing is easily conducted. And not only that but also, by the crystalline alumina fiber mat it is possible to eliminate the high temperature thermal deterioration of the ceramic fiber mat that is on the outer periphery side, and it is possible to achieve a stable fixing of the monolith. Then, because there is no destruction of the fibers, there is no decrease of the supporting force relative to the monolith, and the effect is obtained such that it is said that an even more stable fixing of the monolith is achieved. Also, in the case of the catalyst converter according to the present invention, because of the use of the above described inorganic fiber formed body, the effect is obtained such that it is said that the assembly becomes easy and also, the monolith fixing is stable.

[Simple explanation of the figures]

[Figure 1]

Figure 1 represents a three dimensional view diagram in an assembly state showing the structure of the catalyst converter.

[Figure 2]

Figure 2 is a three dimensional view diagram showing the wrapping outline of the monolith support material relative to the monolith.

[Figure 3]

Figure 3 is a three dimensional view diagram showing part of the monolith support material that has a structure that is obtained from an inorganic fiber formed body.

[Simple explanation of the signs]

1.....monolith
2.....casing
2a.....casing part (upper half part of the metal manufactured casing)
2b.....casing part (bottom half part of the metal manufactured casing)
21a.....flange part
21b.....flange part
3.....monolith supporting part
30.....first inorganic fiber formed mat
31.....second inorganic fiber formed mat
4.....bonding opening (entrance)
5.....bonding opening (exit)

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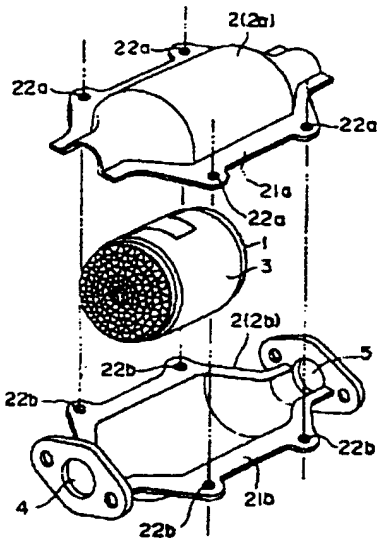
1/24/99

【図1】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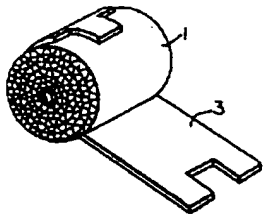
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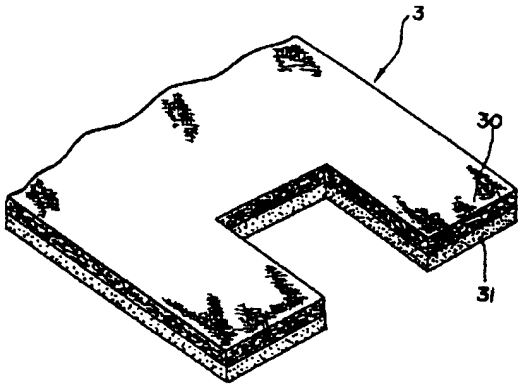
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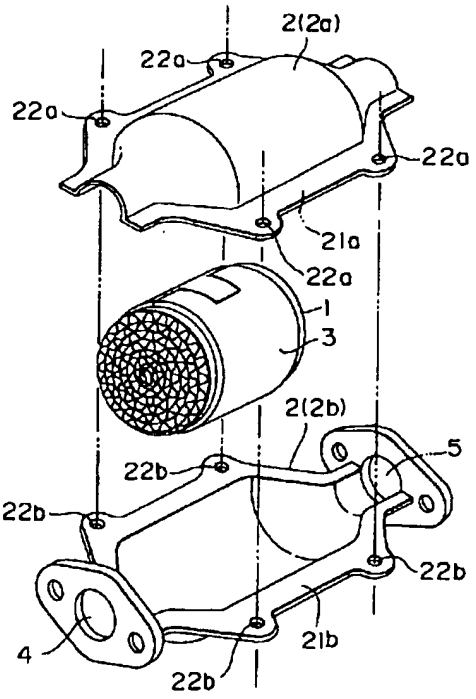
(54)【発明の名称】　無機繊維成形体および触媒コンバーター

(57)【要約】

【課題】　モノリス保持材として使用した際、ケーシングへの装着が容易で且つモノリスを安定的に固定し得る様に改良された無機繊維成形体および当該無機繊維成形体を利用した触媒コンバータを提供する。

【解決手段】　本発明の無機繊維成形体は、第１の無機繊維マットと第２の無機繊維マットとを積層して成る。第１の無機繊維マットは、厚さ方向に圧縮された結晶質アルミナ繊維マットと有機バインダーとから構成され、第２の無機繊維マットは、上記以外のセラミック繊維マットと無機膨張材および有機バインダーとから主として構成される。また、本発明の触媒コンバーターにおいては、上記の無機繊維成形体がモノリス保持材（３）としてモノリス（１）に巻回される。



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【特許請求の範囲】

【請求項１】　第１の無機繊維マットと第２の無機繊維マットとを積層して成る無機繊維成形体であって、第１の無機繊維マットは、厚さ方向に圧縮された結晶質アルミナ繊維マットと当該アルミナ繊維マットに均一に含浸され且つ熱分解によって消失する有機バインダーとから構成され、第２の無機繊維マットは、上記以外のセラミック繊維マットと当該セラミック繊維マットに均一に分散された無機膨張材および均一に含浸され且つ熱分解によって消失する有機バインダーとから主として構成され、無機繊維成形体全体の厚さに対する第１の無機繊維マットの厚さの比率が２０～８０％に設定されていることを特徴とする無機繊維成形体。

【請求項２】　第１の無機繊維マットを構成する結晶質アルミナ繊維がムライト組成の繊維である請求項１に記載の無機繊維成形体。

【請求項３】　第１の無機繊維マットを構成する結晶質アルミナ繊維の平均繊維径が３～８μｍであり且つ繊維長が０．５～５００ｍｍである請求項１又は２に記載の無機繊維成形体。

【請求項４】　筒状に形成され且つ排気ガス浄化用触媒を担持するモノリスと、当該モノリスを収容し且つ排気ガス導管に接続される金属製のケーシングと、前記モノリスに巻回されて当該モノリスと前記ケーシングとの間隙に介装されるモノリス保持材とから構成された触媒コンバーターにおいて、前記モノリス保持材が請求項１～３の何れかに記載の無機繊維成形体であり且つ前記モノリス側に第１の無機繊維マットが配置されていることを特徴とする触媒コンバーター。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、無機繊維成形体および触媒コンバーターに関するものであり、詳しくは、主に自動車に使用される触媒コンバーターのモノリス保持材として使用される無機繊維成形体であって、組立が容易で且つモノリスを安定的に固定し得る無機繊維成形体および当該無機繊維成形体を使用した触媒コンバーターに関するものである。

【０００２】

【従来の技術】触媒コンバーターは、周知の通り、内燃機関の排気ガス中に含まれる一酸化炭素、炭化水素、窒素酸化物などの有害成分を貴金属触媒によって除去する装置である。

【０００３】特開平１－２４０７１５号公報には、無機繊維成形体から成るモノリス保持材を使用した触媒コンバーターが記載されている。上記の無機繊維成形体は、セラミック繊維マットと当該セラミック繊維マットに均一に分散された無機膨張材および均一に含浸され且つ熱分解によって消失する有機バインダーとから主として構成された膨張性マットに対し、アルミナ繊維マットを有機糸でステッチボンディングした積層体であり、膨張性マットの高温熱劣化をアルミナ繊維マットによって防止することを企図したものである。

【０００４】

【発明が解決しようとする課題】しかしながら、モノリス保持材としての上記の無機繊維成形体においては、アルミナ繊維マットが嵩高であるため、触媒コンバーターを組み立てる際、ケーシングへの装着が難しいと言う問題がある。しかも、膨張性マットに対するアルミナ繊維マットの接着の困難性から、有機糸によるステッチボンディングが採用されているが、ステッチボンディングによって繊維が痛み易く、その結果、モノリスに対する保持力が低下すると言う問題がある。

【０００５】本発明は、上記の実情に鑑みなされたものであり、その第１の目的は、モノリス保持材として使用した際、ケーシングへの装着を容易に行い得る様に改良された無機繊維成形体および当該無機繊維成形体を利用した触媒コンバータを提供することにあり、また、本発明の第２の目的は、繊維の痛みがなく、モノリス保持材として使用した際、モノリスに対する保持力を十分に発揮でき、モノリスを安定的に固定し得る様に改良された無機繊維成形体および当該無機繊維成形体を利用した触媒コンバータを提供することにある。

【０００６】

【課題を解決するための手段】すなわち、本発明の第１の要旨は、第１の無機繊維マットと第２の無機繊維マットとを積層して成る無機繊維成形体であって、第１の無機繊維マットは、厚さ方向に圧縮された結晶質アルミナ繊維マットと当該アルミナ繊維マットに均一に含浸され且つ熱分解によって消失する有機バインダーとから構成され、第２の無機繊維マットは、上記以外のセラミック繊維マットと当該セラミック繊維マットに均一に分散された無機膨張材および均一に含浸され且つ熱分解によって消失する有機バインダーとから主として構成され、無機繊維成形体全体の厚さに対する第１の無機繊維マットの厚さの比率が２０～８０％に設定されていることを特徴とする無機繊維成形体に存する。

【０００７】本発明の第２の要旨は、筒状に形成され且つ排気ガス浄化用触媒を担持するモノリスと、当該モノリスを収容し且つ排気ガス導管に接続される金属製のケーシングと、前記モノリスに巻回されて当該モノリスと前記ケーシングとの間隙に介装されるモノリス保持材とから構成された触媒コンバーターにおいて、前記モノリス保持材が上記の無機繊維成形体であり且つ前記モノリス側に第１の無機繊維マットが配置されていることを特徴とする触媒コンバーターに存する。

【０００８】

【発明の実施の形態】本発明の実施形態を図面に基づいて説明する。図１は、触媒コンバーターの構造を示す組立斜視図である。図２は、モノリスに対するモノリス保

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持材の巻回要領を示す斜視図である。図３は、無機繊維成形体により構成されたモノリス保持材の一部を示す斜視図である。

【０００９】本発明の無機繊維成形体は、第１の無機繊維マットと第２の無機繊維マットとを積層して構成される。そして、第１の無機繊維マットとしては、厚さ方向に圧縮された結晶質アルミナ繊維マットと当該アルミナ繊維マットに均一に含浸され且つ熱分解によって消失する有機バインダーとから構成された無機繊維マットが使用される。

【００１０】上記の様な特定構造の第１の無機繊維マットの使用により、本発明の無機繊維成形体は、モノリス保持材として使用した際、嵩高にならず、ケーシングへの装着を容易に行い得ると言う顕著な効果を発揮する。しかも、高温側に結晶質アルミナ繊維の第１の無機繊維マットを配置することにより、後述の第２の無機繊維マットの高温熱劣化が防止される。そして、本発明の好ましい態様においては、上記の結晶質アルミナ繊維としてムライト組成の繊維が使用される。斯かる好ましい態様により、本発明の無機繊維成形体は、モノリス保持材として使用した際、第２の無機繊維マットの高温熱劣化を一層防止でき、モノリスを一層安定的に固定し得ると言う効果を発揮する。

【００１１】第１の無機繊維マットを構成する基材マットは、厚さ方向にほぼ均一に積層したアルミナ繊維の集合体であり、所謂ブランケット又はブロックと呼ばれるものを包含する。アルミナ繊維としては、通常、繊維径が１～５０μｍ、繊維長が０．５～５００ｍｍのものが使用されるが、復元力および形状保持性の観点からは、繊維径が３～８μｍ、繊維長が０．５～３００ｍｍの繊維が特に好ましい。

【００１２】上記アルミナ繊維の組成としては、アルミナ－シリカ系結晶質短繊維であって、シリカ含有率が５重量％以下のアルミナ、すなわち、アルミナが９５重量％以上の高アルミナの他、アルミナが７０～９５重量％で且つ残余がシリカで構成される一般的なものが挙げられる。特に、アルミナ７２～８５重量％のムライト組成の繊維は、高温安定性および弾力性に優れており、好ましいアルミナ繊維である。

【００１３】結晶質アルミナ繊維は、同じアルミナ－シリカ系の非結晶質セラミック繊維と比較して耐熱性に優れ、セラミック繊維の様に軟化収縮などの熱劣化が極めて少ないため、圧縮マットとした場合に弾力性に富んでいる。すなわち、結晶質アルミナ繊維マットは、低い嵩密度で高い保持力を発生し且つその温度変化が少ないと言う性質を持つ。従って、触媒コンバーターのモノリス保持材として使用した際、モノリス（１）と金属製のケーシング（２）との熱膨張の差によってモノリス（１）とケーシング（２）との間隙が変化し、その嵩密度が上昇した場合にも、モノリス（１）に対する保持圧が急激に変化することがない。

【００１４】有機バインダーは、圧縮されたマットの厚さを常温下において維持でき、熱分解による消失後に上記マットの厚さを復元し得るものであれば特に制限なく使用できるが、モノリス（１）の使用温度以上でも分解しない様なもの、更には、有機バインダーを含浸させることによってマットの柔軟性および復元面圧特性を阻害し、モノリス（１）の破壊を助長する様な性質を持つ有機バインダーの使用は、避ける必要がある。有機バインダーとしては、各種のゴム、水溶性有機高分子化合物、熱可塑性樹脂、熱硬化性樹脂などを使用できる。

【００１５】上記ゴム類としては、天然ゴム；エチルアクリレートとクロロエチルビニルエーテルの共重合体、ｎ－ブチルアクリレートとアクリロニトリルの共重合体、エチルアクリレートとアクリロニトリルの共重合体などのアクリルゴム；ブタジエンとアクリロニトリルの共重合体のニトリルゴム；ブタジエンゴム等が挙げられ、水溶性有機高分子化合物としては、カルボキシメチルセルロース、ポリビニルアルコール等が挙げられる。熱可塑性樹脂としては、アクリル酸、アクリル酸エステル、アクリルアミド、アクリロニトリル、メタクリル酸、メタクリル酸エステル等の単独重合体および共重合体であるアクリル樹脂；アクリロニトリル・スチレン共重合体；アクリロニトリル・ブタジエン・スチレン共重合体などが挙げられる。また、熱硬化性樹脂としては、ビスフェノール型エポキシ樹脂、ノボラック型エポキシ樹脂などが挙げられる。

【００１６】上記の有機バインダーを有効成分とした水溶液、水分散型エマルション、ラテックス、有機溶媒溶液（これらを総称して「バインダー液」と言う）が市販されており、これらのバインダー液は、そのまま水などの溶媒で希釈して使用できるため、比較的安価に適用し得る。なお、有機バインダーは一種である必要はなく２種の混合物であってもよい。

【００１７】上記の有機バインダーの中では、アクリルゴム、ニトリルゴム、カルボキシメチルセルロース、ポリビニルアルコール及びアクリルゴム以外のアクリル樹脂の群から選ばれる少なくとも１種が好ましく、特に、アクリルゴム、ニトリルゴム等の合成ゴムのうち柔軟性のあるゴムが有効である。

【００１８】有機バインダー含有量は、特に限定されるものではなく、第１の無機繊維マットを構成する繊維の種類、形状、マットの絶対厚さ、触媒コンバーターの金属製ケーシングに組み込む前の有機バインダーを含む成形体としての厚さ及び反発力によって決定される。有機バインダー含有量は、通常、アルミナ繊維１００重量部に対して有機バインダーの有効成分が３～３０重量部にするのがよい。有機バインダーの含有量が３重量部未満の場合は、基材マットの反発によって成形体としての厚さを維持できない虞があり、３０重量部を超える場合

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は、コスト高になる他、成形体の柔軟性が損なわれる虞が生ずる。斯かる観点から、有機バインダーの上記割合は５～２０重量部の範囲が好ましい。

【００１９】第１の無機繊維マットは、結晶質アルミナ繊維の基材マットに有機バインダー液を含浸させる工程、有機バインダー液を含浸させたマットを厚さ方向に圧縮する工程、圧縮したままの状態で有機バインダー液の溶媒分を除去する工程を経て製造される。

【００２０】第１の無機繊維マットは、次の様な特性を有しているのが好ましい。すなわち、仮に、第１の無機繊維マットのみでモノリス保持材を構成した場合、モノリス外周面とケーシング内面との間隙に相当する厚さの圧縮状態において、０．１～８．０ｋｇｆ／ｃｍ2 の復元力を有しているのが好ましい。斯かるの復元力は、モノリスがセラミックス製の場合で０．５～８．０ｋｇｆ／ｃｍ2 程度とされ、モノリスが金属製の場合で０．１～４．０ｋｇｆ／ｃｍ2 程度とされる。

【００２１】上記の復元力は、マットに均一に含浸された有機バインダーが熱分解によって消失した後に発現する。マットの復元力は、モノリス外周面とケーシング内面との間隙に相当する厚さにマットを圧縮するのに要する力（圧縮力）に相当する。従って、本発明においては、マット形成時の圧縮力によって上記の復元力の指標としている。

【００２２】第２の無機繊維マット（膨張性マット）は、上記以外のセラミック繊維マットと当該セラミック繊維マットに均一に分散された無機膨張材および均一に含浸され且つ熱分解によって消失する有機バインダーとから主として構成される。そして、第２の無機繊維マットは、特開平１－２４０７１５号公報に記載の触媒コンバータにおける保持材と同様の膨張性マットとして機能し、６００℃以下の比較的低い温度領域で優れた膨張性を発揮する。

【００２３】上記セラミック繊維としては、アルミナ系およびアルミナ－シリカ系以外のセラミック繊維、例えば、アルミノケイ酸塩繊維（ファイバーフラックス、セラファイバー及びカオーウール等の商品）、石綿繊維、ガラス繊維などが挙げられ、上記の無機膨張材としては、中空ガラス微小球、ベントナイト、膨張性バーミュキュライト、金雲母、パーライト、膨張性黒鉛、膨張性フッ化雲母などが挙げられ、有機バインダーとしては、前述と同様の物質が挙げられる。

【００２４】上記の各成分の使用割合は、セラミック繊維：１０～５０重量%、無機膨張剤：２０～６５重量%、有機バインダー：３～２０重量%とされる。また、マットの形成は、周知の抄造法により行うことが出来、必要により、抄造して得たシートの積層化によってマットを形成してもよい。なお、膨張性マットには、必要に応じその他の無機充填材として例えばセピオライト鉱物などを含有させることが出来る。

【００２５】本発明において、無機繊維成形体全体の厚さに対する第１の無機繊維マットの厚さの比率は、第２の無機繊維マット（膨張性マット）の高温熱劣化を有効に防止する観点から２０～８０%、好ましくは４０～８０%に設定されていることが重要である。すなわち、第１の無機繊維マットの厚さの比率が２０%未満の場合は、第２の無機繊維マット（膨張性マット）の高温熱劣化を十分に防止することが出来ない。また、第１の無機繊維マットの厚さの比率が８０%を超えた場合は、第２の無機繊維マットに熱が伝わり難くなり、当該第２の無機繊維マットの膨張材が十分に膨張しなくなる虞がある。

【００２６】本発明の無機繊維成形体において、第１及び第２の無機繊維マットは、例えば次の様な方法で積層することが出来る。ｉ）バインダーで固められた第１及び第２の無機繊維マットを接着剤で貼着する方法、ii）第２の無機繊維マットの上において、第１の無機繊維マット用の基材マットを積層た後、当該基材マットに有機バインダー液を含浸させ、次いで、厚さ方向に圧縮した後、圧縮したままの状態で有機バインダー液の溶媒分を除去する方法である。

【００２７】上記の様な方法によれば、上述の有機バインダーを含む接着剤によって２つのマットを貼着した構造を構成できる。すなわち、上記の方法によれば、従来のステッチボンディングの様に、嵩高にならず且つ各マットの繊維を破損することがなく、その結果、モノリス保持材として使用した際、装着性を向上でき且つモノリスに対する保持力の低下を防止できる。

【００２８】図３に示す様に、本発明の無機繊維成形体をモノリス保持材（３）として使用する場合には、触媒コンバータ組立時のモノリス保持材（３）の捩れやずれを防止するため、図２に示す様に、モノリス（１）に巻回した際に互いに噛合わせ可能な接続部が巻回方向の両端部に設けられる。斯かる接続部は、裁断加工などによって容易に形成できる。なお、図３中、符合（３０）は第１の無機繊維マット、符合（３１）は第２の無機繊維マット、符合（３）は本発明の無機繊維成形体としてのモノリス保持材を示す。

【００２９】本発明の無機繊維成形体から成るモノリス保持材（３）のモノリス（１）への巻回は、モノリス（１）側に第１の無機繊維マット（３０）が位置する様に行う。すなわち、モノリス（１）側に第１の無機繊維マット（３０）を配置することにより、第２の無機繊維マット（３１）の高温熱劣化を防止できる。

【００３０】本発明の触媒コンバーターは、図１に示す様に、概略、筒状に形成され且つ排気ガス浄化用触媒を担持するモノリス（１）と、モノリス（１）を収容し且つ排気ガス導管に接続される金属製のケーシング（２）と、モノリス（１）に巻回されて当該モノリスとケーシング（２）との間隙に介装される前述のモノリス保持材

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（３）とから構成される。

【００３１】モノリス（１）としては、コーディエライト等を主成分とするセラミックスによって構成されたモノリスの他、金属箔素材によって構成されたモノリスを使用することも出来る。特に、Ｆｅ、Ｃｒ、Ａｌ又はＳｉを基本成分とするフェライト系ステンレス箔は、触媒を担持させる際のコート材および触媒との馴染みが良く、しかも、触媒担持後の熱的変化が比較的少ないため、金属製モノリスを構成するのに好適な素材である。モノリス（１）には、通常、Ｐｔ、Ｐｈ等の貴金属層を担持させることにより、触媒としての機能を付与される。

【００３２】ケーシング（２）は、当該ケーシングの上半分を構成するケーシング部材（２ａ）及び下半分を構成するケーシング部材（２ｂ）の２つ部材を合わせて一体化する２分割のクラムシェル構造を備えている。ケーシング部材（２ａ）及び（２ｂ）は、各々、フランジ部（２１ａ）、（２１ｂ）を有し、フランジ部（２１ａ）、（２１ｂ）は、ケーシング部材（２ａ）及び（２ｂ）を溶接する際の接合面として機能する。また、一方のケーシング部材（２ｂ）の両端部には、排気ガス導管へ接続するための接続口（４）、（５）が設けられる。図１中、符号（２２ａ）及び（２２ｂ）は、自動車の車体などに固定するためのボルト穴を示す。なお、金属製ケーシングとしては、予め筒状に形成されてモノリスが装入されるスタッフィング構造のケーシングを採用することも出来る。

【００３３】ケーシング（２）にモノリス（１）を収容する場合、モノリス（１）外周面とケーシング（２）内面とで形成される間隙に対し、モノリス保持材（３）が同じ厚さを有する必要はなく、僅かに厚いものまで装着が可能である。しかしながら、厚すぎた場合やケーシング（２）との滑りが悪い場合には、モノリス保持材（３）の繊維の一部がフランジ部（２１ａ）、（２１ｂ）の接合面にはみ出し、溶接が不可能となる等の不都合を生ずるため、その厚さは上記の間隙の１．０～２．０倍に設定される。斯かる設定値の上限は、好ましくは１．７倍、更に好ましくは１．６とされる。

【００３４】本発明の触媒コンバーターは、主に、自動車の排気ガス管に取り付けられる。本発明の触媒コンバーターにおいては、内燃機関から排出される高温の排気ガスを通過させた際、モノリス（１）、ケーシング（２）及びモノリス保持材（３）が昇温し、第１の無機繊維マット（３０）及び第２の無機繊維マット（３１）に含浸された有機バインダーが熱分解によって消失し、第１の無機繊維マット（３０）が復元力を発揮すると共に、第２の無機繊維マット（３１）が無機膨張材の膨張によって体積膨張する。すなわち、モノリス（１）は、第１の無機繊維マット（３０）の厚さの復元力および第２の無機繊維マット（３１）の体積膨張によって固定される。

【００３５】しかも、本発明においては、モノリス（１）側に耐熱性に優れた第１の無機繊維マット（３０）が位置する様にモノリス保持材（３）が巻回されているため、モノリス保持材（３）の第２の無機繊維マット（３１）の熱劣化を有効に防止でき、温度変化に基づくモノリス（１）外周面とケーシング（２）内面との間隙の変化に追従してモノリス（１）に対する面圧を十分に保持できる。更に、上述した様に、モノリス保持材（３）においては繊維の痛みがないため、モノリス（１）に対する保持力の低下がなく、一層安定的にモノリス（１）を固定し得る

【００３６】

【発明の効果】以上説明した様に、本発明の無機繊維成形体によれば、モノリス保持材として使用した際、ケーシングへの装着を容易に行い得ると言う顕著な効果を奏する。しかも、結晶質アルミナ繊維マットにより外周側のセラミック繊維マットの高温熱劣化を防止でき、モノリスを安定的に固定できる。そして、繊維の破損がないため、モノリスに対する保持力の低下がなく、一層安定的にモノリスを固定し得ると言う効果を奏する。また、本発明の触媒コンバーターによれば、上記の無機繊維成形体の使用により、組立が容易となり且つモノリスを安定的に固定し得ると言う効果を奏する。

【図面の簡単な説明】

【図１】触媒コンバーターの構造を示す組立斜視図である。

【図２】モノリスに対するモノリス保持材の巻回要領を示す斜視図である。

【図３】無機繊維成形体により構成されたモノリス保持材の一部を示す斜視図である。

【符号の説明】

１　：モノリス
２　：ケーシング
２ａ　：ケーシング部材（金属製ケーシングの上半分）
２ｂ　：ケーシング部材（金属製ケーシングの下半分）
２１ａ：フランジ部
２１ｂ：フランジ部
３　：モノリス保持材
３０　：第１の無機繊維マット
３１　：第２の無機繊維マット
４　：接続口（入口）
５　：接続口（出口）

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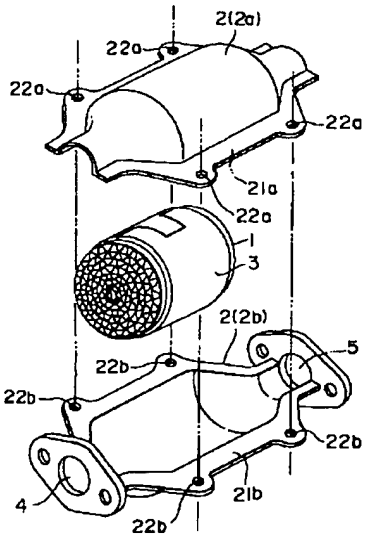
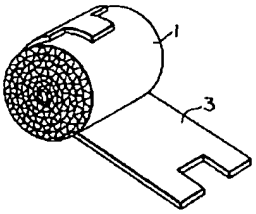
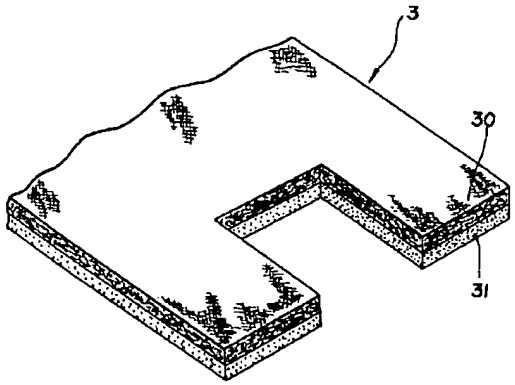
【図１】



【図２】



【図３】



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